

Date: December 2, 2022

To: Tim Raney, Raney Planning and Management

From: Dane H. Schilling, PE  
Laurie Loaiza, PE

Subject: Wheatland Regional Sewer Pipeline Project Hydraulic Impact Memorandum

This memorandum is intended to summarize the potential hydrologic impacts of stormwater and groundwater to the Wheatland Regional Sewer Pipeline Project (WRSPP).

### **Project Description**

The WRSPP will install eight miles of new sanitary sewer force main and three pump stations. The WRSPP will convey wastewater from the City of Wheatland's (City) to the Olivehurst Public Utilities District (OPUD) treatment facility via a connection point located off Rancho Road, north of State Route 65 (SR 65) and South Beale Road. (See Appendix A for the project Vicinity Map.) The goal of the WRSPP is to increase the City's wastewater capacity by replacing the existing aged wastewater plant.

The WRSPP is divided into several pieces, including three pipeline segments, three pump stations and the decommissioning of the existing wastewater treatment plant as described below:

- **Pipeline Segment 1** includes approximately 1.7 miles of sanitary sewer force main connecting Pump Station 1 (PS1) located at Malone Avenue near Main Street with Pump Station 2 (PS2) located on Spenceville Road 700-feet east of the intersection with Jasper Lane.
- **Pipeline Segment 2** includes approximately 2.5 miles of sanitary sewer force main beginning at PS2 and ending at the point the pipeline turns off Jasper Road onto undeveloped farmland.
- **Pipeline Segment 3** includes approximately 3.6 miles of sanitary sewer force main connecting Segment 2 to Pump Station 3 (PS3) located on Rancho Road off Highway 65.
- **Pump Station 1 (PS1)** is approximately 0.4 acres located at the City's existing Malone Pump Station between Malone Avenue and SR 65.
- **Pump Station 2 (PS2)** is approximately 3.6 acres located on the south side of Spenceville Road about 800-feet east of Jasper Lane.
- **Pump Station 3 (PS3)** is approximately 0.8 acres located on the northerly corner of the intersection of Rancho Road and Highway 65 in unincorporated Yuba County.

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- **Existing Wastewater Treatment Plant (WWTP)** is located at the south end of Malone Avenue, adjacent to the Bear River in Wheatland, CA.

FEMA Flood Insurance Rate Maps (FIRM) and FEMA's on-line National Flood Hazard Layer (NFHL) were used to evaluate the impact of stormwater and identify flood zones within the project area. Appendix B: FEMA Maps contains flood maps for the pipeline and three pumpstations. An overall flood hazard map can be found in Appendix B.

The Geotechnical Basis of Design Report by Blackburn Consulting dated March 2022 was used to evaluate groundwater concerns for each area. Geotechnical boring locations, subsurface condition tables and plans from that report can be found in Appendix C.

### **Pipeline Segment 1**

**Segment 1** of the pipeline will be constructed entirely underground at a minimum depth of 4-ft below finished ground surface predominantly using open-cut construction. The project will include jack-and-bore crossings at Highway 65 and at the UPRR track south of Main Street. The pipe trenches for the entire segment will be restored to original ground surface elevations except at the Pump Station sites. Approximately 95% will be constructed within existing paved roadways.

#### Hydraulic Impacts

The mapped flood zones (Appendix Figure B2) in this area are:

- *Zone X-Area of Minimal Flood Hazard* ("Zone X"). Approximately 70% of Segment 1 is in this zone.
- *Zone X-Area with Reduced Flood Risk Due to Levee* ("Zone X-Protected by Levee"). Approximately 15% of Segment 1 is in areas protected by the Bear River Levee.
- *Zone A-Special Flood Hazard Area 1% Annual Chance Flood* ("Zone A"). About 15% of Segment 1 crosses three isolated Zone A areas that are subject to localized interior flooding.

Areas of potential hydrologic impact in Segment 1 include:

- The pipe will cross three low lying areas shown as Zone A at the beginning of Segment 1. The construction of the pipeline will not generate any impacts to base flood elevations (BFEs). However, any pipe appurtenances such as air and vacuum valves, blow-offs, and vents for casings under the railroad should be installed at elevations above the 100-year BFEs or flood-proofed so the appurtenances function as planned in a 100-year storm event.
- Two existing 42" corrugated metal pipe culverts connect South Grasshopper Slough across State Street. The existing pipes are in poor condition; debris has accumulated inside and around the pipes impeding flow through the culvert. See Figure 1 below. Open-cut installation of the Segment 1 pipeline in State Street will require the removal of the existing culvert pipes and the clearing of the channel within the limits of the City's right of way. The culvert and headwalls will be replaced in-kind with conduits of

equivalent capacity. Hydrologic flow will be improved, and the natural invert restored due to the improvements to the existing channel and the cleared culvert.



*Figure 1: Existing South Grasshopper Slough Culvert*

Geotechnical groundwater findings in this area are summarized below (Appendix C):

- The highest groundwater encountered 19.0 feet below surface at Boring B-04, on the southeast side of State Highway 65.
- Deepest ground water encountered was at Grasshopper Slough on State Street in the City. Water was encountered at a depth of 23.5 feet below surface at Boring B-06.
- No ground water was encountered between borings B-08, south of the intersection of Sixth street and B street, and boring B-16 located at the intersection of Spenceville Road and Jasper Lane. Boring depths varied between 10 and 21.5 feet.
- In the vicinity of SR 65, Boring B-4 encountered groundwater at a depth of 19.0 feet and Boring B-5 encountered water at a depth of 21.5 feet.
- Near UPRR Crossing #1 Boring B-6 encountered groundwater at 23.5 feet below the surface. Groundwater was not encountered at Boring B-7, which drilled to a depth 31.5 feet,

Important areas to note in Segment 1:

- The jack-and-bore crossings at SR 65 encountered ground water at a depth at or greater than 19 feet below the surface. Due to the depth below the surface, the water is not anticipated to interfere with the jack-and-bore process, receiving or launching pits.

- The jack-and-bore crossings at UPRR Crossing #1 is not expected to be impacted by the groundwater because the launching and receiving pits are located above the encountered ground water.
- Although groundwater is not anticipated within the trench, sump pumps would be sufficient to dewater excavations if necessary. Details for groundwater handling and disposal will be addressed in the SWPPP.

No adverse hydraulic impacts are expected because of the construction of Segment 1. The replacement of the State Street culvert pipes will improve the current storm water capacity, as the current facility is a CMP pipe in poor condition and the invert is overburdened with sediment.

## **Pipeline Segment 2**

**Segment 2** of the pipeline will be constructed with a minimum depth of 4-ft below finished ground surface using primarily open-cut construction. The segment additionally includes a horizontal directional drill (HDD) crossing 50 feet beneath the Dry Creek levee. Pipe trenches for the will be restored to original ground surface elevations. Approximately 90% of the segment will be constructed within existing paved roadways.

### Hydraulic Impacts

The mapped flood zones (Appendix Figure B3) in this area are:

- *Zone X-Area of Minimal Flood Hazard* (“Zone X”). Approximately 75% of the segment is in this zone.
- *Zone A-Special Flood Hazard Area 1% Annual Chance Flood* (Zone A). About 25% of the pipeline crosses Zone A associated with Dry Creek flooding.

Areas of potential hydrologic impact in Segment 2 are:

- The section of pipe located within Zone A near Dry Creek and the levee on the south side of Dry Creek includes HDD and open-trench installation. HDD installation below Dry Creek and the levee will mitigate any potential hydrologic impacts.
- The pipeline will not generate any impacts to base flood elevations (BFEs) in this segment. However, any pipe appurtenances such as air and vacuum valves and blow-offs should be installed at elevations above the 100-year BFEs or flood-proofed so the appurtenances will function in a 100-year storm event.

Geotechnical groundwater findings in this area are summarized below (Appendix C):

- Ground water was not encountered within 10 feet of the surface, except the deep borings at Dry Creek.
- Typical boring depths were between 10.0 feet and 11.5 feet.
- Dry Creek Boring B-21 encountered water at a depth of 25.0 feet and Boring B-22 encountered water at a depth of 26.3 feet.

### Important areas to note in Segment 1:

- Groundwater is not anticipated to have a negative impact on the HDD under the Dry Creek levee. The depth of groundwater discovered at Dry Creek is below the elevation of the launch and receiving areas. Groundwater is anticipated at the HDD drill depth. The groundwater will not interfere with the drilling operations, however, if a spill or facets out were to occur spill and containment kits will be on site to contain any fluid. Disposal shall comply with all State and Federal regulations.
- Groundwater is not anticipated within the trench for the open cut pipeline. Any groundwater encountered can be dewatered using sump pumps. Details for groundwater handling and disposal will be addressed in the SWPPP.

No adverse hydraulic impacts are anticipated because of the construction of Segment 2.

### Pipeline segment 3

**Segment 3** of the pipeline will be constructed primarily via open cut with a minimum depth of 4-ft below finished ground surface and deeper in active agricultural crop areas. A horizontal direction drill (HDD) crossing beneath Best Slough and four jack and bore crossings (one at an irrigation canal, and three railroad ROW) are also planned. Pipe trenches for the entire segment will be restored to original ground surface elevations. Approximately 90% of the segment will be constructed in undeveloped or agricultural areas.

#### Hydraulic Impacts

The mapped flood zones (Appendix Figure B4) in this area are:

- *Zone X-Area of Minimal Flood Hazard* (“Zone X”). Approximately 85% of the segment is in this zone.
- *Zone A-Special Flood Hazard Area 1% Annual Chance Flood* (Zone A). About 15% of the pipeline crosses Zone A associated with Dry Creek flooding.

Areas of potential hydrologic impact in Segment 3 are:

- The portion of the pipe that crosses Best Slough is located within Zone A. HDD installation below Best Slough will eliminate any potential hydrologic impacts for this section.
- The pipeline itself will not generate any impacts to base flood elevations (BFEs) in this segment. However, any pipe appurtenances such as air and vacuum valves and blow-offs should be installed at elevations above the 100-year BFEs or flood-proofed so the appurtenances function as planned even in a 100-year storm event.

Geotechnical groundwater findings in this area are summarized below (Appendix C):

- Typical boring depths were between 9.9 feet and 13 feet. Deeper borings were taken at Best Slough and the three UPRR crossings. Groundwater was not encountered within 10 feet of the surface.

- No water was encountered at the following borings: Irrigation Channel crossing Boring B-36 (11.5 feet below ground), Boring B-48 at south of the pipeline, UPRR crossing Boring B-50 at the southern spur of the railroad, UPRR crossing Boring B-53 at the northern spur of the railroad, UPRR crossing Boring B-58 and B-59, located at Rancho Road
- Ground water was encountered at a depth of 38 feet at Best Slough boring B-47. This is not expected to impact HDD operations. Best Slough is often dry in late summer. Coordinating construction work to be done in the late summer would further the probability of encountering groundwater.
- Ground water was not encountered at the jack-and-bore crossings.
- Groundwater was not encountered and is not anticipated within trench, launching, or receiving pits, however, if encountered sump pumps would be sufficient to dewater excavations. Details for groundwater handling and disposal will be addressed in the SWPPP.

No adverse hydraulic impacts are expected because of the construction of Segment 3.

### **Pump Station 1**

**Pump Station 1 (PS1)** will be constructed at the location of the City's existing Malone Pump Station which lies in *Zone A-Special Flood Hazard Area 1% Annual Chance Flood* ("Zone A"). (See Appendix B) The site will include underground piping, underground storage tanks, a deep underground wet well and an operation building. Most of the site will be paved to facilitate the operation and maintenance of the facility. Storm water will be drained by sheet-flow, collected in drain inlets and discharge to South Grasshopper Slough via drainage pipes. Adjacent to the site is South Grasshopper Slough which drains runoff from the southerly areas of Wheatland.

#### Hydraulic Impacts

Areas of potential hydrologic impact for PS1 are:

- The site is in Zone A with localized low velocity flooding associated with South Grasshopper Slough. This will be mitigated by placing fill to raise the site to at least 1-foot above the 100-year base flood elevation in accordance with Section 15.20.150 of the City's municipal code for buildings constructed in Zone A.
- This site is in close proximity to South Grasshopper Slough, and to avoid any direct impacts to the slough a retaining wall will be constructed along the top of the channel outside the 30-foot setback from the stream to retain the fill required to elevate the site approximately 4-feet. Since the wall is positioned outside of the channel, the wall will not alter the channel's hydraulic capacity.
- New paved surfaces will increase runoff volume and intensity. Calculations will be performed to determine the increase in volume and intensity of runoff from the site. Any increases will be mitigated as needed through detention of storm water in oversized

pipes prior to discharge and controls on pipe outlets. Pipe outlets will include erosion control measures such as rip-rap rock slope protection.

Geotechnical groundwater findings (Appendix C) are summarized below:

- Boring B-01 (depth 41 feet), located in the vicinity of the proposed chemical tank, encountered groundwater at depth 19.0 feet.
- No groundwater was measured at Boring CPT-1 (depth 20 feet), located in the vicinity of the wet well or at Boring CPT- 2 (depth 10 feet), located east of the control building.

Potential groundwater impact at PS1:

- A wellpoint dewatering system will be needed to reduce the groundwater flow into the deeper excavations of the storage tanks and wet well. Ground water should be drawn down to a minimum of 3 feet below the planned bottom of excavation.
- Groundwater encountered will be collected, decanted to settle solids and discharged to adjacent lands. Alternatively, the adjacent detention storm water basin may be used for decanting suspended solids and/or disposal through percolation in the basin.
- Dewatering can be reduced by planning excavations for the lowest anticipated seasonal water levels, which are expected to occur in late summer and fall months.
- Details for groundwater handling and disposal will be addressed in the SWPPP.

## **Pump Station 2**

**Pump Station 2 (PS2)** will be constructed on the south side of Spenceville Road about 700-feet east of Jasper Lane. The site lies entirely in *Zone X-Area of Minimal Flood Hazard* ("Zone X"). See Appendix Figure B6. The site will include underground piping, up to three partially buried storage tanks, a deep underground wet well and an operations building. The majority of the site will be paved to facilitate the operation and maintenance at the facility. Storm water on site will be drained by sheet-flow over pavements, collected in storm drain inlets, conveyed to water quality basins and eventually discharged to Grasshopper Slough just south of the site.

### Hydraulic Impacts

- New paved surfaces will increase runoff volume and intensity. Calculations will be performed to determine the increase in volume and intensity of runoff from the site. Any increases will be mitigated through on-site storm water detention basins. Pipe outlets will include erosion control measures such as rip-rap rock slope protection.

Geotechnical groundwater findings (Appendix C) are summarized below:

- No groundwater was encountered in either Boring B-02 (depth 31.5 feet) located at the southeast corner or Boring B-61 (depth 6.5 feet) located in the northeast corner.
- Groundwater was not measurable at the two 50-foot deep borings, Boring CPT-3 and CPT-4, located in the proximity of the proposed equalization tanks.

Groundwater is not expected to impact construction of PS2.

### **Pump Station 3**

**Pump Station 3 (PS3)** will be constructed on the northerly corner of the intersection of Rancho Road and Highway 65 in unincorporated Yuba County. The site lies entirely in *Zone X-Area of Minimal Flood Hazard* (“Zone X”). (Appendix B) The site will include underground piping, an underground wet well and a small operations building. A portion of the site will be paved to facilitate the operation and maintenance at the facility. Storm water on site will be drained by sheet-flow over pavements and eventually discharged to the existing drainage ditch along the westerly edge of the site.

Areas of potential hydrologic impact for PS3 are:

- New paved surfaces will increase runoff volume and intensity. Calculations will be performed to determine the increase in volume and intensity of runoff from the site. Any increases will be mitigated through on-site storm water detention. Outlets will include erosion control measures such as rip-rap rock slope protection.

Geotechnical groundwater findings (Appendix C) are summarized below:

- Boring B-03 (depth 41.5 feet) located on the eastern side of the site did not encounter groundwater.
- No groundwater was encountered in either Boring B-51 (depth 11.5 feet) located in the southern portion of the site or in Boring B-52 (depth 11.5 feet) located in the western portion of the site.
- Although groundwater is not anticipated to be an issue during construction; it may be encountered due to inflow from the surrounding irrigated agricultural fields. Any groundwater encountered will be collected, decanted to settle solids and discharged to adjacent lands or drainage ditches. Groundwater handling and disposal will adhere to State requirements be addressed as part of the project SWPPP.

### **Existing Wastewater Treatment Plant (WWTP) Decommissioning:**

The existing WWTP is located near the south end of Malone Avenue, adjacent to the Bear River in Wheatland. The site, located on the north side of the Bear River levee, lies within *Zone X-Area with Reduced Flood Risk Due to Levee* (“Zone X-Protected by Levee”). After the new connection to the OPUD WWTP is completed, tested and operational the Wheatland WWTP will be decommissioned. Items to be demolished include an aeration basin, secondary clarifier, sludge drying beds and operations building.

The exact scope of work will require approval by the State. It will likely necessitate soil testing for the presence of contaminated soils, removal of any contaminated soils (if applicable), demolition and removal of all above ground structures to at least 5-feet below grade, removal or abandoning-in-place of underground piping, filling in of treatment ponds (as required), and leveling the ground to a smooth surface with proper drainage.

The existing WWTP site includes rapid infiltration basins on the south (unprotected) side of the Bear River Levee within unincorporated Sutter County. The basins lie within Zone AE-Special Flood Hazard Area Subject to 1% Annual Chance Flood with Base Flood Elevations Determined and are subject to flood damage. This portion of the facility was damaged in a winter storm in January 2006 requiring emergency repairs and issuance of a notice of violation for an unpermitted discharge to the Bear River from the Central Valley Regional Water Quality Control Board. Decommissioning of the rapid infiltration basin will require soil testing for the presence of contaminated soils, removal of contaminated soils (if applicable), removal of existing 175-feet of secondary effluent discharge piping in the levee, backfilling trench, and repair of penetrations in the levee. The City has two options for decommissioning the infiltration basins as follows:

- 1) The infiltration basins would remain and the existing constructed dirt berm around the southern end of the infiltration basins would be breached to allow water to flow through during storm events that cause the Bear River to rise to the point of inundating the basin area(s).
- 2) The existing berm would be used to fill the basins and grade the site to mimic surrounding landforms. Since the surrounding native riverbed soils were used to form the basins it is expected that the basin embankment soils will be spread over the existing footprint to fill in the basin and grade the site without any import or export soils.

Areas of potential hydrologic impact for WWTP Decommissioning include:

- Water quality impacts for disturbed soils due to removal of rapid infiltration basins within the Bear River overbank area. Erosion control measures should be established and included in the Project SWPPP.
- Repair of all pipe penetrations in the Bear River Levee should be included in the engineering drawings for the decommissioning.

In conclusion, no adverse hydraulic impacts are expected because of the construction of the pipelines and pump stations described above.

**Appendix A: Vicinity Map**



### **Appendix B: FEMA FIRM Maps**


Source: FEMA Flood Map Service Center


Location map and pipeline segment backgrounds are downloaded from the National Flood Hazard Layer (NFHL) viewer. <https://hazards-fema.maps.arcgis.com/apps/webappviewer>.

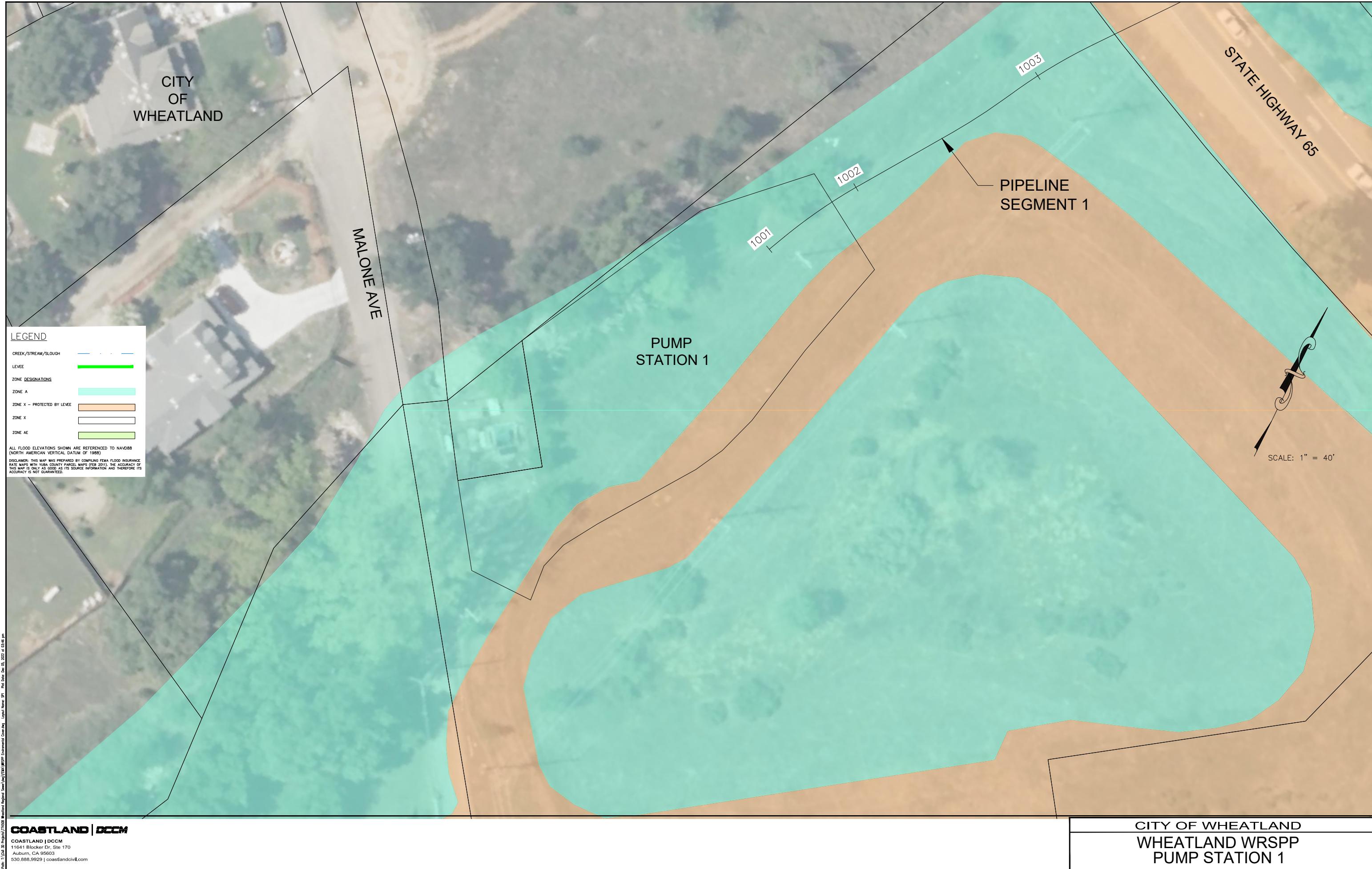
Figures:

- B1. Wheatland Flood Zone Map (Sheets 1-3)
- B2. Pump Station 1 Flood Zone Map
- B3. Pump Station 2 Flood Zone Map
- B4. Pump Station 3 Flood Zone Map
- B5. Existing WWTP Flood Zone Map

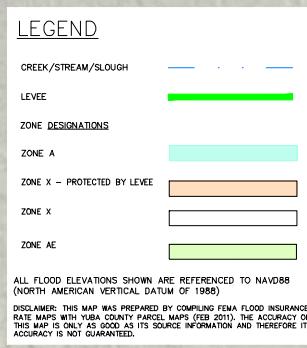






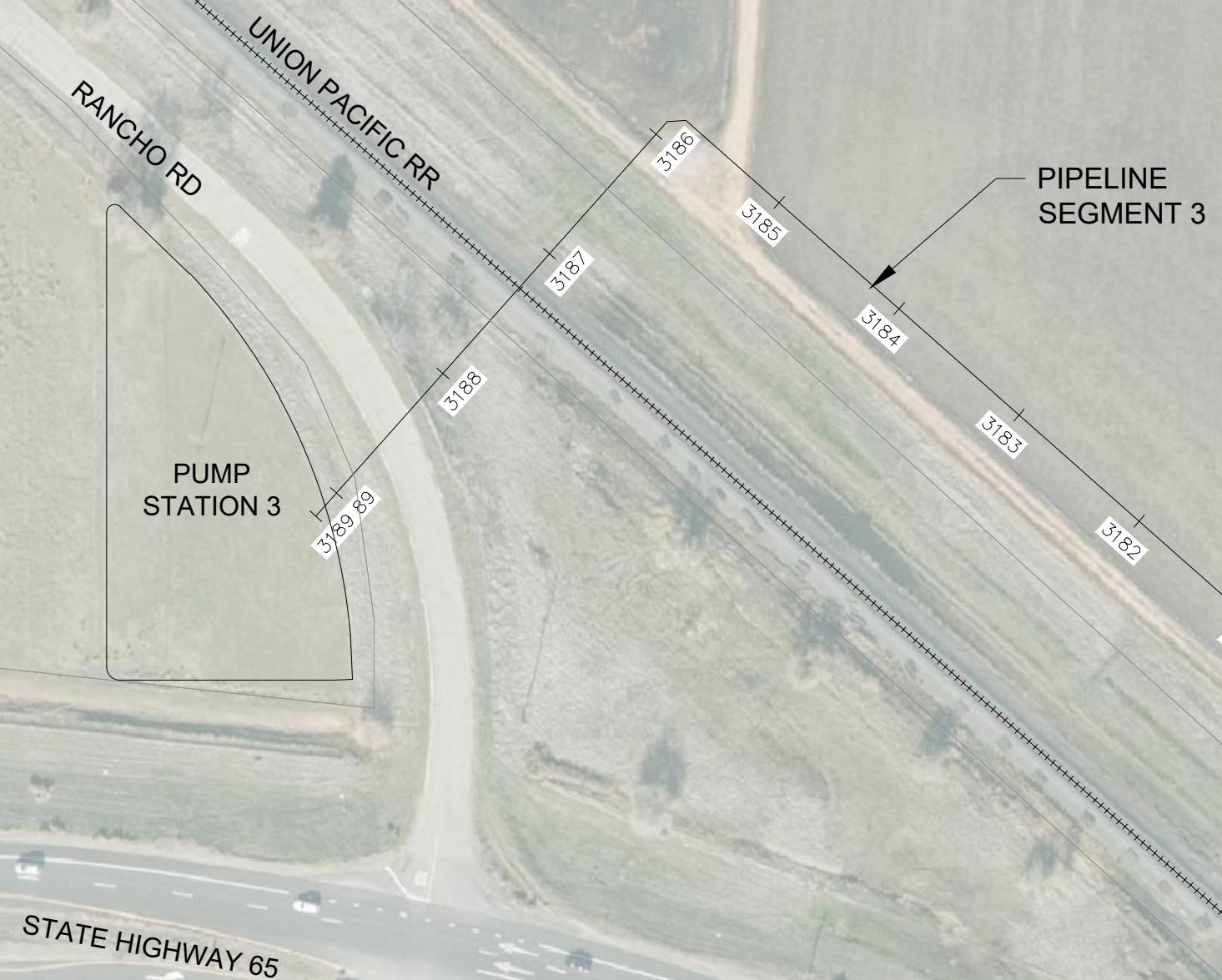






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**CITY OF WHEATLAND**  
**WHEATLAND WRSPP**  
**PUMP STATION 3**



## **Appendix C: Geotechnical Data**

Source: Geotechnical Basis of Design Report

By: Blackburn Consulting

Date: March 2022

### **Figures:**

- C1. Figure 2: Overall Site Plan
- C2. Table 5.1 Subsurface Soil Conditions (page 19 & 20)
- C3. Table 5.2 Subsurface Soil Conditions at Proposed Bore and Jack Crossing (page 21 & 22)
- C4. Table 5.3 Subsurface Soil Conditions at Proposed HDD Crossing (Page 23)
- C5. Table 5.4 Subsurface Conditions (Page 24)
- C6. Overall Pipeline Site Plan (Appendix A1a)
- C7. Pipeline Site Plans (Appendix A1b through A1t)



2/17/2021 3934.x Fig2 Wheatland Sewer.dwg

**Notes:**

1. Refer to Appendix A1 for detailed site plan of sewer pipeline.
2. Refer to Appendix B1 for detailed site plans of trenchless crossings.
3. Refer to Appendix D1 for detailed site plans of pump stations.
4. Historic borings not shown for clarity.



## OVERALL SITE PLAN

Wheatland Regional Sewer Connection Project  
Yuba County, California

File No. 3934.x

March 2022

Figure 2

Table 5.1: Subsurface Soil Conditions

Reach ID (Approximate Station)	Boring ID	Boring Depth <sup>2</sup> (ft)	Boring Elevation <sup>2</sup> (ft)	Approximate Boring Station	Existing Pavement		Depth to GW <sup>2</sup> (ft)	Mapped Geologic Unit <sup>1</sup>	USDA Soil Type <sup>1</sup>	General Subsurface Soil Conditions within upper 10 feet <sup>2</sup>
					AC <sup>2</sup> (in)	AB <sup>2</sup> (in)				
Reach 1 (1001+85-1007+00)	B-04	38.0	79.3	1003+40	NE <sup>4</sup>	NE <sup>4</sup>	19.0	Laguna Formation	Redding gravelly loam / Conejo loam	Stiff to hard lean clay to sandy lean clay and medium dense clayey sand.
	B-05	31.5	78.3	1004+50	NE <sup>4</sup>	NE <sup>4</sup>	21.5	Laguna Formation	Redding gravelly loam	
Reach 2 (1007+00-1022+00)	B-06	31.5	83.3	1008+50	6	NE <sup>4</sup>	23.5	Laguna Formation	Redding gravelly loam	Stiff to hard lean clay to sandy/gravelly lean clay in the upper 8 ft. underlain by medium dense to very dense clayey sand and clayey gravel. Pockets of clayey sand in the upper 2 ft.
	B-07	31.5	81.3	1009+80	NM <sup>3</sup>	NM <sup>3</sup>	NE <sup>4</sup>	Laguna Formation	Redding gravelly loam	
Reach 3 (1022+00-1054+00)	B-08	11.5	83.3	1017+90	2.5	NE <sup>4</sup>	NE <sup>4</sup>	Laguna Formation	Redding gravelly loam	Stiff to very stiff lean clay to lean clay with sand in the upper 1.5 to 4 ft. underlain by medium dense to very dense clayey sand.
	B-09	11.5	92.3	1027+00	2.5	NE <sup>4</sup>	NE <sup>4</sup>	Laguna Formation	Redding gravelly loam	
Reach 4 (1054+00-1071+00)	B-10	11.5	90.3	1034+90	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Laguna Formation	Redding gravelly loam	Dense sand with clay, silty sand, and clayey sand in the upper 1 to 4 ft. underlain by hard lean clay, sandy lean clay, and elastic silt.
	B-11	11.5	100.3	1043+00	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Laguna Formation	Redding gravelly loam	
Reach 5 (1071+00-1080+00)	B-12	10.8	100.3	1051+20	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Laguna Formation	Redding gravelly loam	Dense sand with clay, silty sand, and clayey sand in the upper 1 to 4 ft. underlain by hard lean clay, sandy lean clay, and elastic silt.
	B-13	10.0	98.9	1059+20	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Laguna Formation	Redding gravelly loam	
Reach 6 (1084+00-2008+52)	B-14	10.3	91.3	1067+20	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Laguna Formation	Redding gravelly loam	Very stiff to hard sandy lean clay.
	B-15	10.5	103.3	1075+20	NE <sup>4</sup>	18	NE <sup>4</sup>	Laguna Formation	Redding gravelly loam	
Reach 7 (1080+00-1084+00 & 2008+52-2050+00)	B-16	10.5	112.3	1082+80	NE <sup>4</sup>	18	NE <sup>4</sup>	Laguna Formation	Redding gravelly loam	Very stiff to hard lean clays and silts to sandy silts in the upper 6 to 9 ft. underlain by medium dense to dense sands, silty sands, and clayey sands (very stiff sandy silt in Boring B-20).
	B-17	11.5	92.3	2017+20	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Laguna Formation	Redding gravelly loam	
Reach 8 (2050+00-2088+00)	B-18	11.5	86.3	2025+20	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Holocene Alluvium	Conejo loam	
	B-19	11.5	86.3	2033+10	7	5	NE <sup>4</sup>	Holocene Alluvium	Conejo loam	
Reach 9 (2088+00-3081+00)	B-20	11.5	87.3	2041+10	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Holocene Alluvium	Conejo loam	
	B-21	46.5	90.7	2046+50	NE <sup>4</sup>	NE <sup>4</sup>	25.0	Holocene Alluvium	Conejo loam	
Pipeline Segment Two	B-22	46.5	92.3	2051+60	11	8	26.3	Riverbank Formation	Conejo loam	Interbedded layers of hard lean clay to gravelly lean clay and medium dense to very dense silty sand and clayey sand to clayey gravel.
	B-23	10.9	93.3	2058+80	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-24	11.5	93.3	2066+50	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-25	11.5	94.3	2074+80	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-26	11.5	93.3	2082+80	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
Pipeline Segment Three	B-27	11.5	94.3	2090+90	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	Very stiff to hard lean clay to sandy lean clay. Pockets of dense silty to clayey sand in borings B-30, B-37, B-40, of hard fat clay in boring B-31, and of hard sandy silt in B-35.
	B-28	11.5	96.3	2098+90	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-29	10.0	97.3	2106+90	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-30	11.5	97.3	2114+80	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-31	10.0	97.3	2122+90	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-32	11.5	98.3	2130+80	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-33	9.9	94.3	3005+60	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-34	11.2	94.3	3014+10	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-35	10.5	93.3	3022+60	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-36	11.5	91.3	3031+00	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-37	10.8	90	3039+60	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-38	11.5	87.6	3048+50	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	

Table 5.1: Subsurface Soil Conditions

Reach ID (Approximate Station)	Boring ID	Boring Depth <sup>2</sup> (ft)	Boring Elevation <sup>2</sup> (ft)	Approximate Boring Station	Existing Pavement		Depth to GW <sup>2</sup> (ft)	Mapped Geologic Unit <sup>1</sup>	USDA Soil Type <sup>1</sup>	General Subsurface Soil Conditions within upper 10 feet <sup>2</sup>
					AC <sup>2</sup> (in)	AB <sup>2</sup> (in)				
	B-39	11.5	89.3	3057+60	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-40	11.5	88.3	3066+60	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-41	11.5	87.3	3075+60	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
Reach 10 (3081+00-3118+00)	B-42	11.5	83.3	3085+70	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam / Hollenbeck silty clay loam	Hard lean clay to sandy lean clay in the upper 8 to 10 ft. underlain by medium dense to dense clayey sand.
	B-43	13.0	81.3	3093+00	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-44	13.0	80.3	3102+10	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-45	11.5	79.3	3112+10	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
Reach 11 (3118+00-3147+00)	B-46	11.5	74.3	3122+30	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Holocene Basin Deposits	Conejo loam	Very stiff to hard lean clay to sandy lean clay. Very dense silty sand below 4 ft. in boring B-49.
	B-47	46.0	76.6	3128+20	NE <sup>4</sup>	NE <sup>4</sup>	38.0	Holocene Basin Deposits	Conejo loam	
	B-48	45.8	80.7	3129+70	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Holocene Basin Deposits / Laguna Formation	San Joaquin loam	
	B-49	10.8	80.3	3136+20	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Laguna Formation	San Joaquin loam	
	B-50	31.0	78.3	3143+00	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Laguna Formation	San Joaquin loam	
Reach 12 (3147+00-3189+53)	B-53	31.3	79.3	3152+10	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	Stiff to hard lean clay and lean clay with sand in the upper 7 to 10 ft. (3 ft. in boring B-58) underlain by medium dense to very dense clayey sand.
	B-54	31.5	79.5	3162+30	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-55	31.5	81.3	3162+90	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-56	11.5	78.3	3171+90	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-57	11.5	78.3	3177+60	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-58	36.5	78.3	3185+80	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	
	B-59	31.5	76.6	3188+40	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	

1 Refer to Section 3.1 for description of geologic formation and USDA mapped soil type.

2 Depths and elevations are approximate.

3 Not measured.

4 Not encountered.

Table 5.2: Subsurface Soil Conditions at Proposed Bore and Jack Crossings

Crossing	Boring ID	Boring Depth <sup>2</sup> (ft)	Approximate Boring Station	Existing Pavement		Depth to GW <sup>2</sup> (ft)	Mapped Geologic Unit <sup>1</sup>	USDA Soil Type <sup>1</sup>	General Subsurface Soil Conditions <sup>2</sup>
				AC <sup>2</sup> (in)	AB <sup>2</sup> (in)				
SR-65	B-4	38.0	1003+40	NE <sup>4</sup>	NE <sup>4</sup>	19.0	Laguna Formation	Redding gravelly loam / Conejo loam	Medium stiff to hard lean clay to sandy lean clay with lenses of loose to medium dense clayey sand in the upper 25 ft. underlain by medium dense clayey sand and very dense sand to a depth of 37.5 ft. Hard lean clay with sand in the deepest 0.5 ft. explored.
	B-5	31.5	1004+50	NE <sup>4</sup>	NE <sup>4</sup>	21.5			
UPRR 1	B-6	31.5	1008+50	6	NE <sup>4</sup>	23.5	Laguna Formation	Redding gravelly loam	Very stiff to hard lean clay in the upper 8 ft. underlain by 5 to 8 ft. of dense clayey gravel to hard gravelly clay with sand. Interbedded lean clays, sandy silts and silty sands from approximately 14 ft. below ground surface to maximum depth explored.
	B-7	31.5	1009+80	NM <sup>3</sup>	NM <sup>3</sup>	NE <sup>4</sup>			
UPRR 2	B-50	31.0	3143+00	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Laguna Formation	San Joaquin loam	Hard lean clay in the upper 15 ft. underlain by 5 ft. of hard sandy silt. Very dense clayey sand from 20 ft. deep to 25 ft. underlain by hard silt and sandy silt to the maximum depth explored.
UPRR 3	B-53	31.3	3152+10	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	Hard lean clay in the upper 10 ft. underlain by lenses of very dense silty, clayey sand and stiff lean clay with sand. Hard silt to silt with sand from 18 ft. to the maximum depth explored.

Pipeline Segment One

Segment Three



Table 5.2: Subsurface Soil Conditions at Proposed Bore and Jack Crossings

Crossing	Boring ID	Boring Depth <sup>2</sup> (ft)	Approximate Boring Station	Existing Pavement		Depth to GW <sup>2</sup> (ft)	Mapped Geologic Unit <sup>1</sup>	USDA Soil Type <sup>1</sup>	General Subsurface Soil Conditions <sup>2</sup>
				AC <sup>2</sup> (in)	AB <sup>2</sup> (in)				
UPRR 4	B-58	36.5	3185+80	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	Hard lean clay in the upper 33 ft. with a 10-ft.-thick, dense clayey sand layer from 3 to 13 ft. Hard sandy silt from 33 ft. to the maximum depth explored.
	B-59	31.5	3188+40	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Riverbank Formation	San Joaquin loam	Hard lean clay in the upper 23 ft. with a 4-ft.-thick, dense clayey sand layer from 10 to 14 ft. Very dense silty sand from 23 ft. to 27 ft. underlain by hard lean clay with sand to the maximum depth explored.

1 Refer to Section 3.1 for description of geologic formation and USDA mapped soil type.

2 Depths and layer thicknesses are approximate

3 Not measured.

4 Not encountered.

Segment Three

Table 5.3: Subsurface Soil Conditions at Proposed HDD Crossings

Crossing	Boring ID	Boring Depth <sup>2</sup> (ft)	Approximate Boring Station	Existing Pavement		Depth to GW <sup>2</sup> (ft)	Mapped Geologic Unit <sup>1</sup>	USDA Soil Type <sup>1</sup>	General Subsurface Soil Conditions <sup>2</sup>
				AC** (in)	AB** (in)				
Best Slough	B-47	46.0	3128+20	NE <sup>4</sup>	NE <sup>4</sup>	38.0	Holocene Basin Deposits	Conejo loam	Very stiff to hard silts and lean clays with varying amounts of sand in the upper 33 to 35 ft. underlain by interbedded lenses of hard lean clays to sandy silts and medium dense to very dense sands and silty sands to the maximum depth explored.
	B-48	45.8	3129+70	NE <sup>4</sup>	NE <sup>4</sup>	NE <sup>4</sup>	Holocene Basin Deposits / Laguna Formation	San Joaquin loam	
Dry Creek	B-21	46.5	2046+50	NE <sup>4</sup>	NE <sup>4</sup>	25.0	Holocene Alluvium	Conejo loam	Very dense sandy, gravelly fill in the upper 3 ft. Native very stiff to hard lean clay and silt to a depth of 12 ft. underlain by 30 ft. of medium dense to dense sand to clayey sand. Hard lean clay from 43 feet deep to the maximum depth explored.
	B-22	46.5	2051+60	11	8	26.3	Riverbank Formation		Very dense clayey gravel to hard gravelly clay in the upper 7 ft. underlain by very stiff to hard lean clay, silt, and silt with sand to maximum depth explored.

1 Refer to Section 3.1 for description of geologic formation and USDA mapped soil type.

2 Depths and layer thicknesses are approximate

3 Not measured.

4 Not encountered.

Table 5.4: Subsurface Conditions

Pump Station	Boring ID	Boring Depth <sup>2</sup> (ft)	Approximate Station	Depth to GW <sup>2</sup> (ft)	Mapped Geologic Unit <sup>1</sup>	USDA Soil Type <sup>1</sup>	General Subsurface Soil Conditions <sup>2</sup>
PS 1	B-01	41.0	1001+85	19	Laguna Formation	Redding gravelly loam / Conejo loam	Stiff to hard lean clay to sandy lean clay in the upper 20.5 ft., underlain by approximately 2 ft of dense well-graded sand with clay and gravel. Hard lean clay to sandy lean clay from approximately 22.5 ft. to the maximum depth explored of approximately 41 ft.
	CPT 1	20.0		NM <sup>3</sup>			
	CPT 2	10.0		NM <sup>3</sup>			
PS 2	B-02	31.5	1090+16	NE <sup>4</sup>	Laguna Formation	Redding gravelly loam	Soft to stiff lean clay with sand in the upper 2 to 5 ft. underlain by 2 to 6 ft. of dense to very dense silty sand. Very stiff to hard lean clay and silt at 6 to 8 ft. deep down to 20 to 25 ft. deep underlain by medium stiff to very stiff sandy lean clay and clay to the maximum depth explored of 50 ft.
	B-61	6.5		NE <sup>4</sup>			
	CPT 3	50.0		NM <sup>3</sup>			
	CPT 4	50.0		NM <sup>3</sup>			
PS 3	B-03	41.5	3189+53	NE <sup>4</sup>	Riverbank Formation	San Joaquin Loam	Very stiff to hard lean clay to sandy lean clay in the upper 38 ft. underlain by 3 ft. of dense to very dense sand over hard lean clay with sand to the maximum depth explored of approximately 41.5 ft.
	B-51	11.5		NE <sup>4</sup>			
	B-52	11.5		NE <sup>4</sup>			

1 Refer to Section 3.1 for description of geologic formation and USDA mapped soil type.

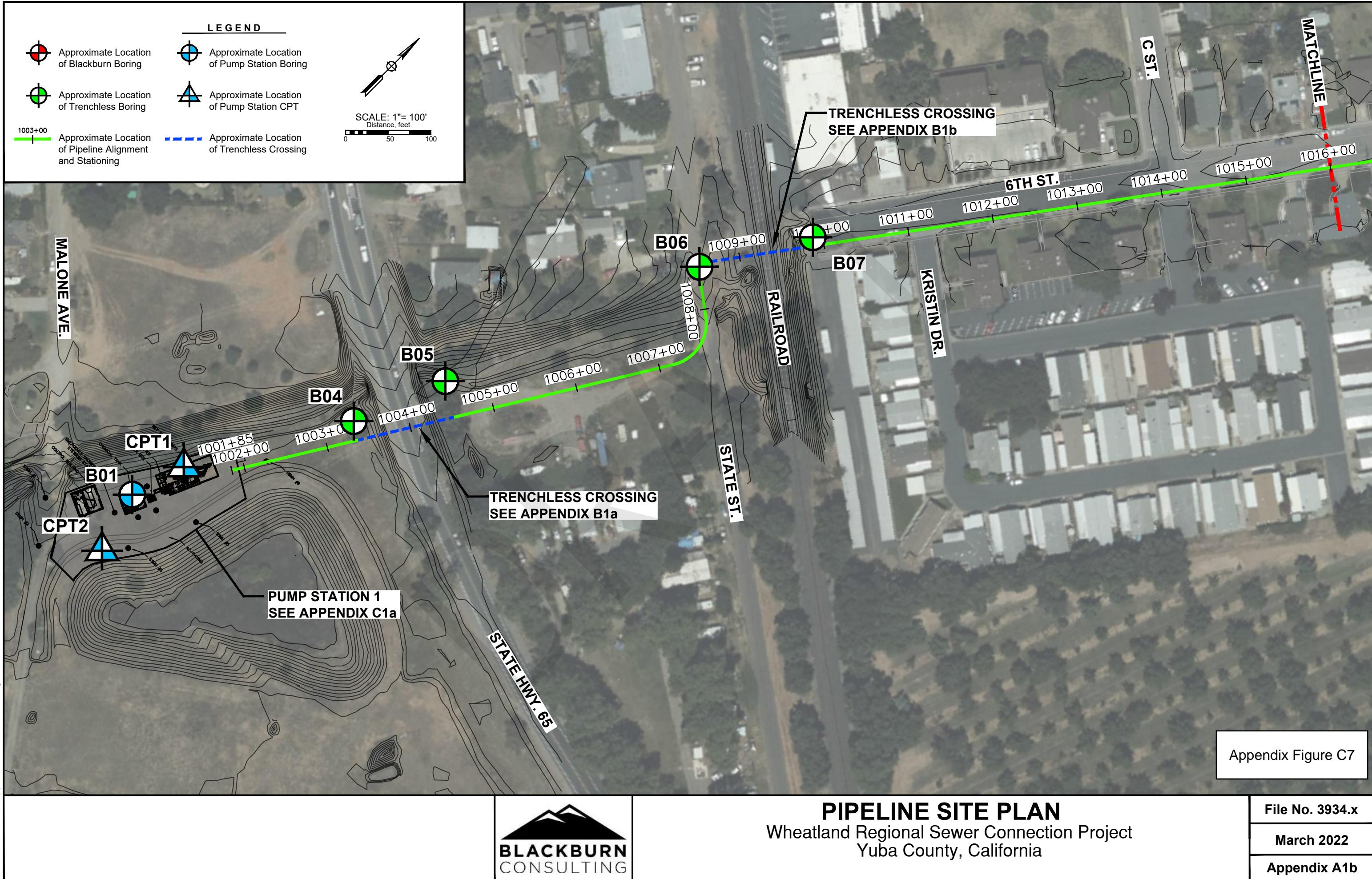
2 Depths and layer thicknesses are approximate

3 Not measured.

4 Not encountered.



**OVERALL PIPELINE SITE PLAN**  
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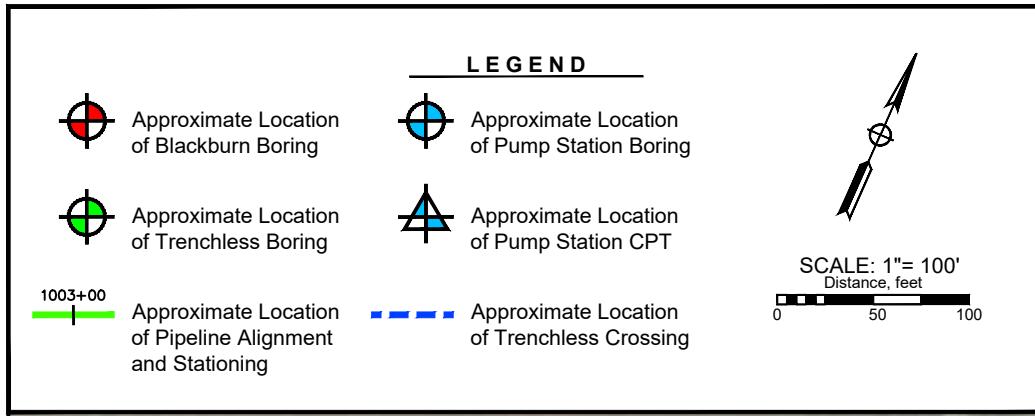
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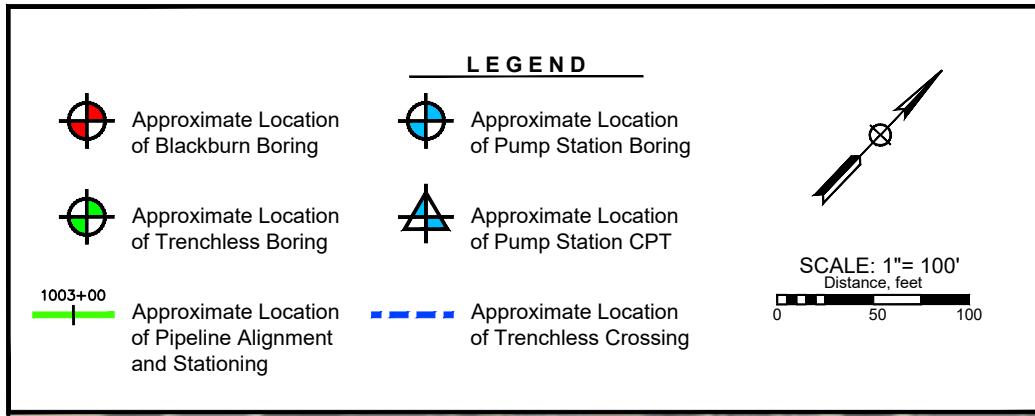


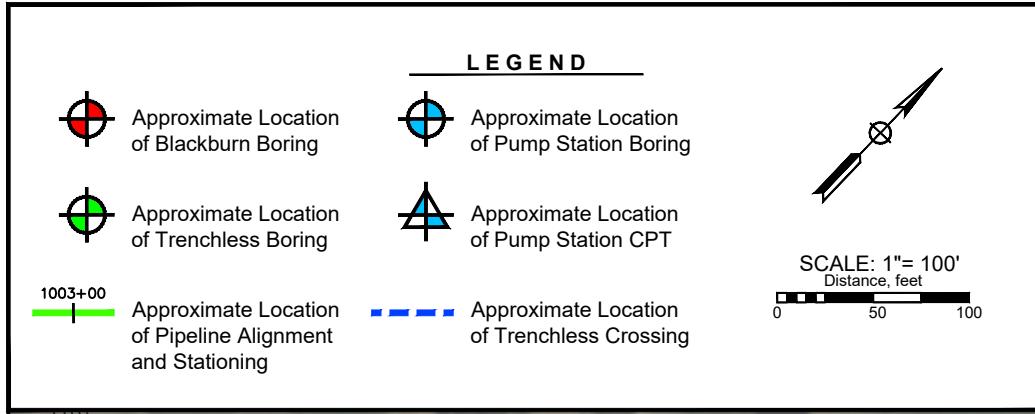
## PIPELINE SITE PLAN

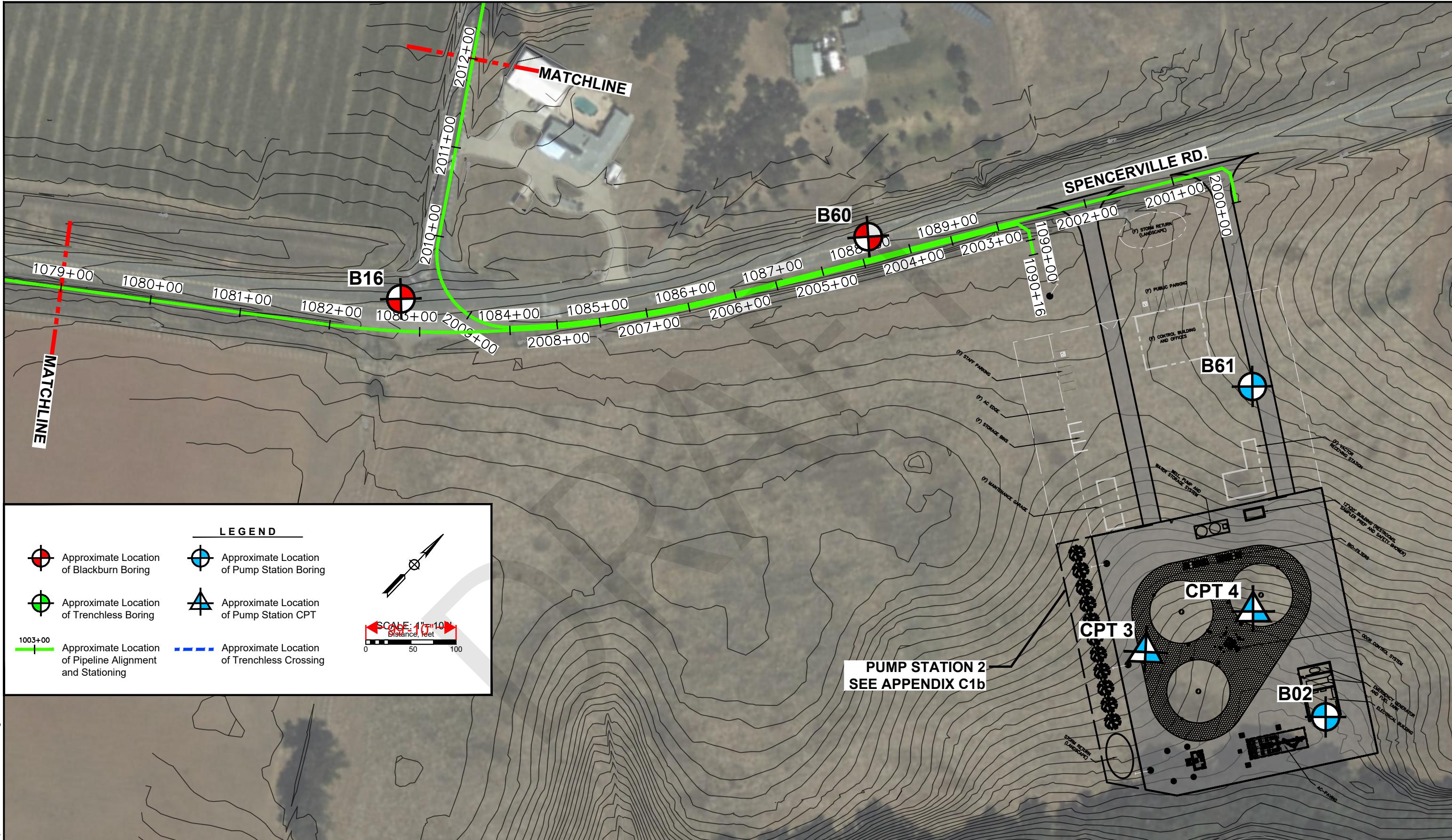
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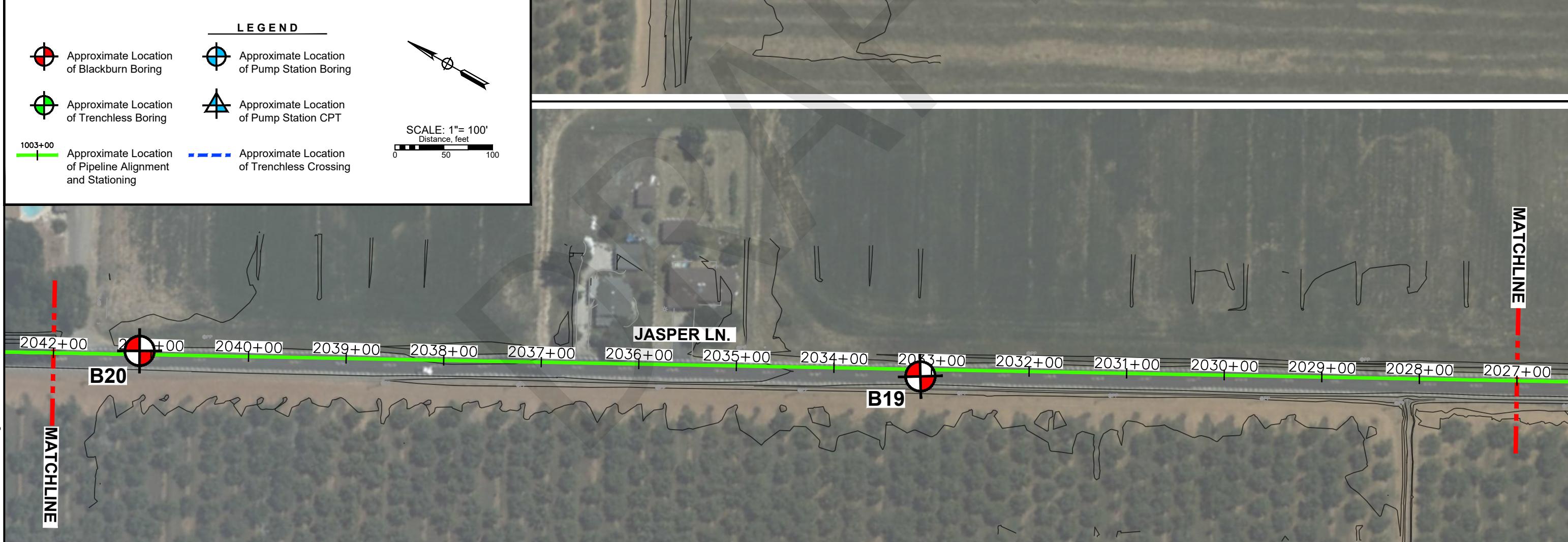
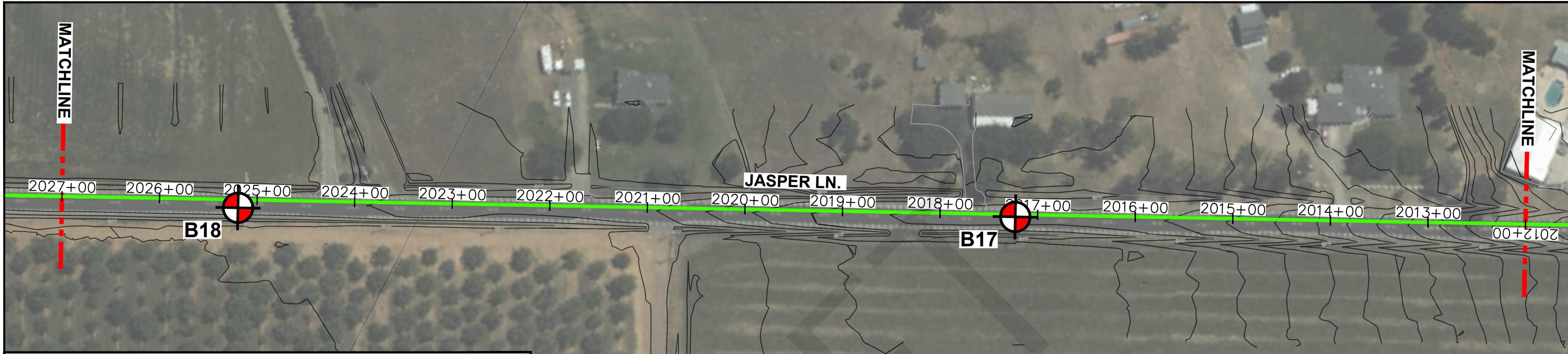


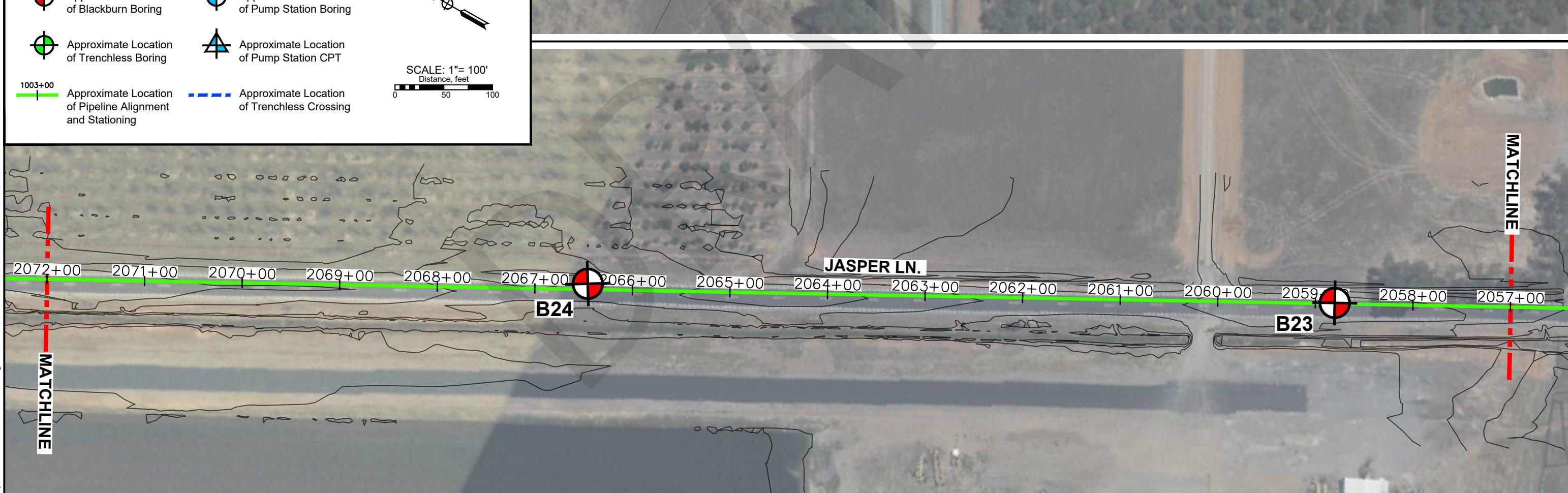
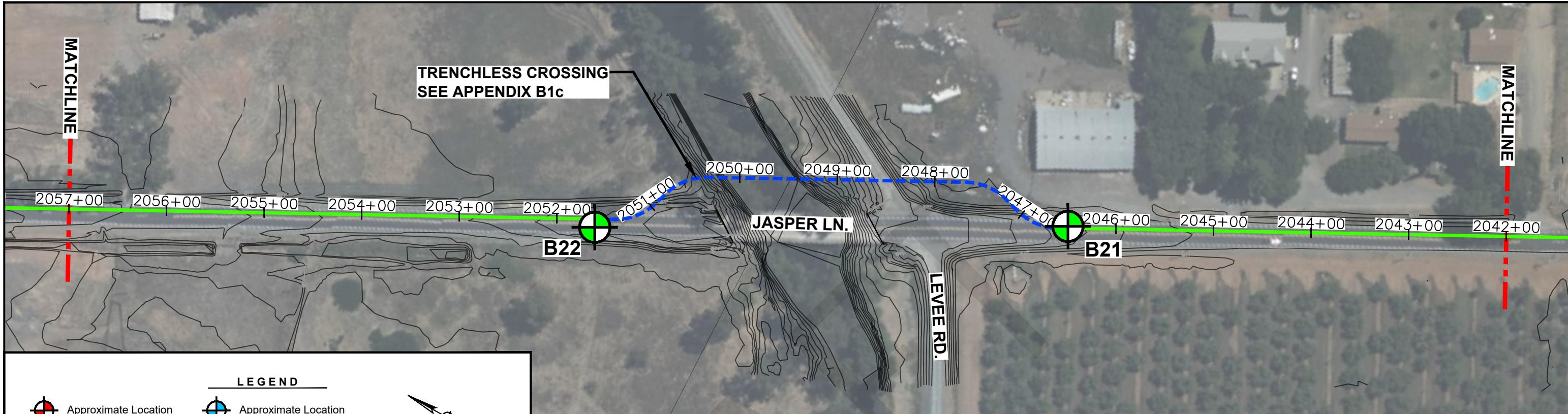


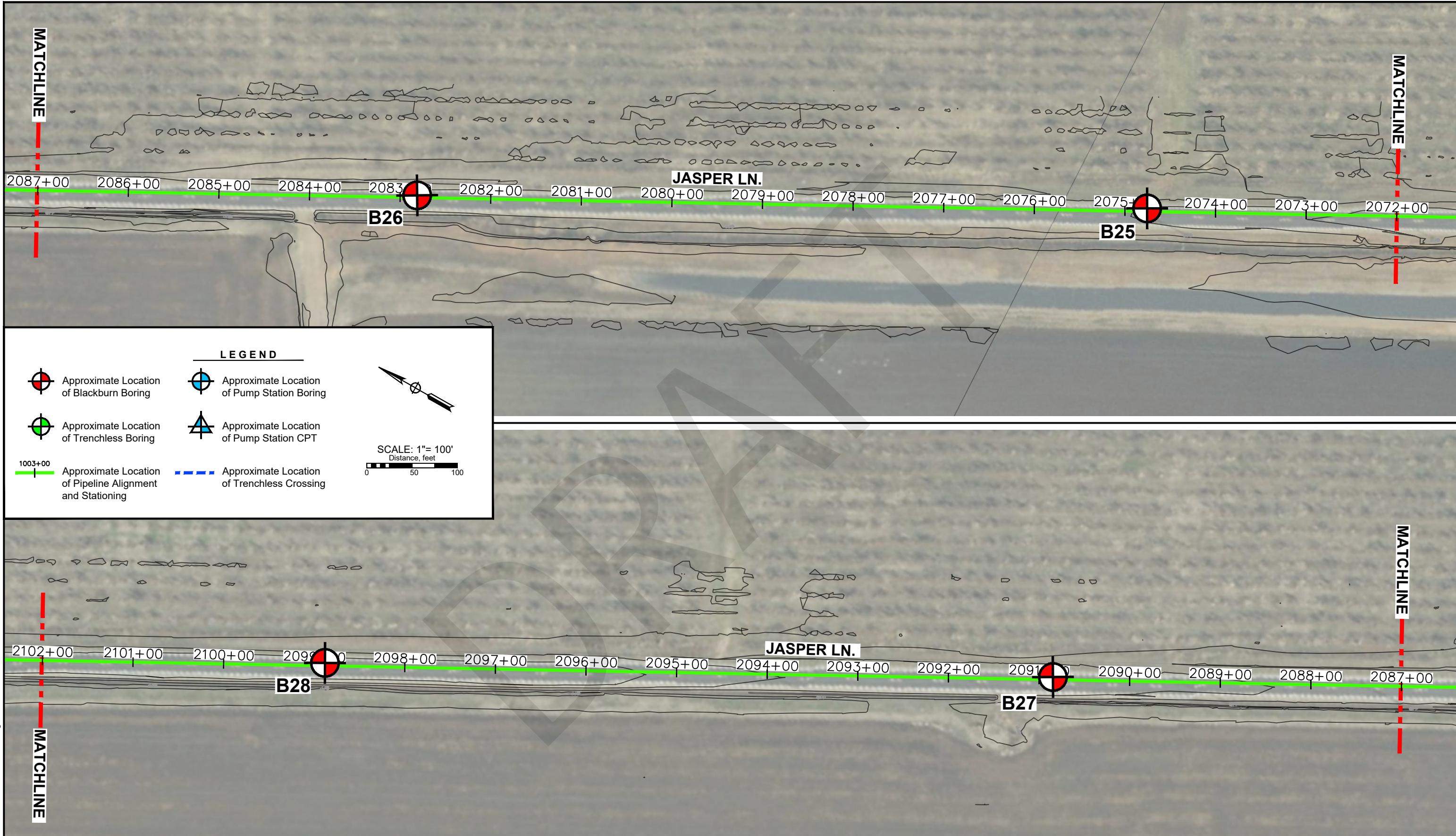
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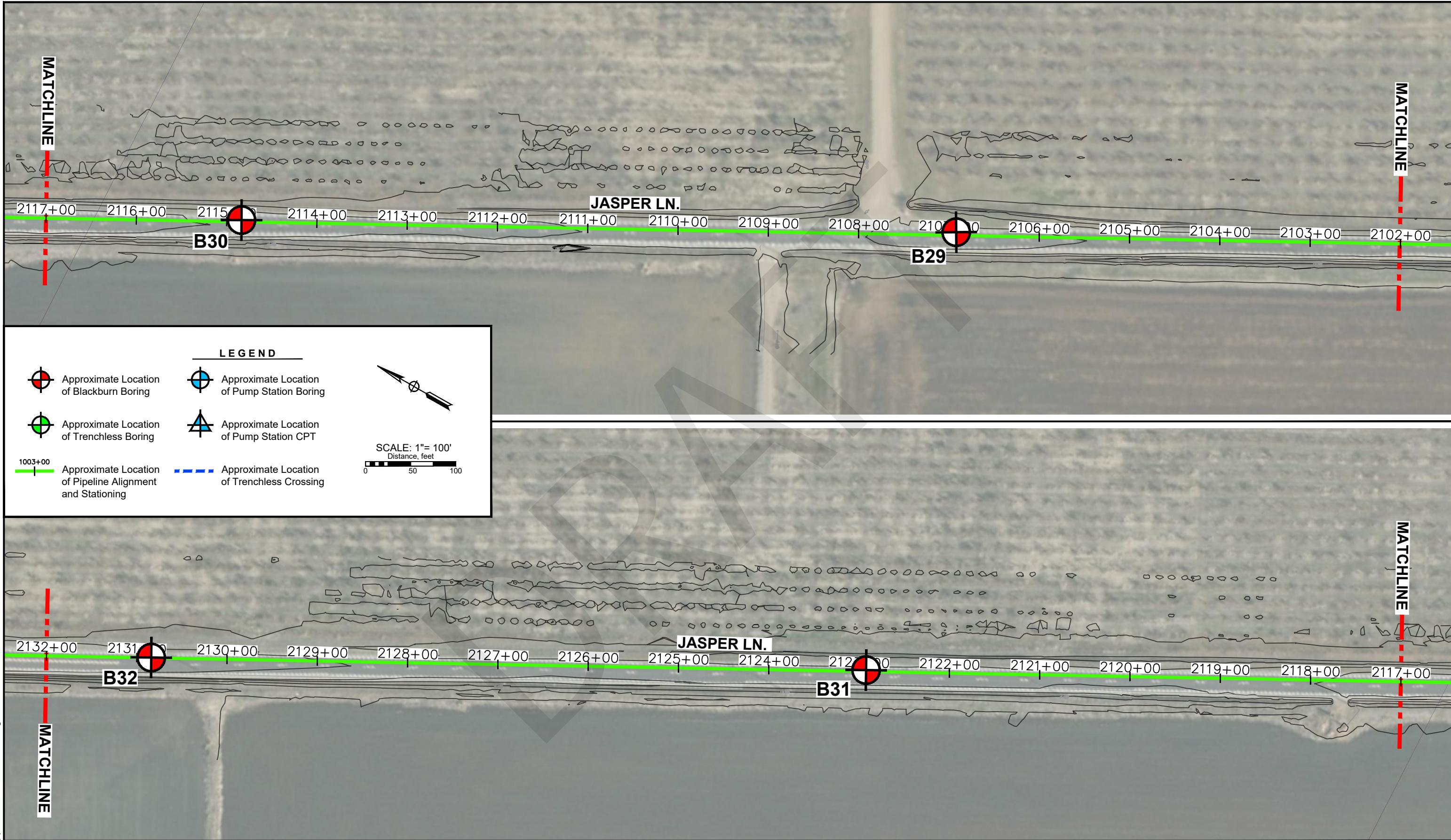


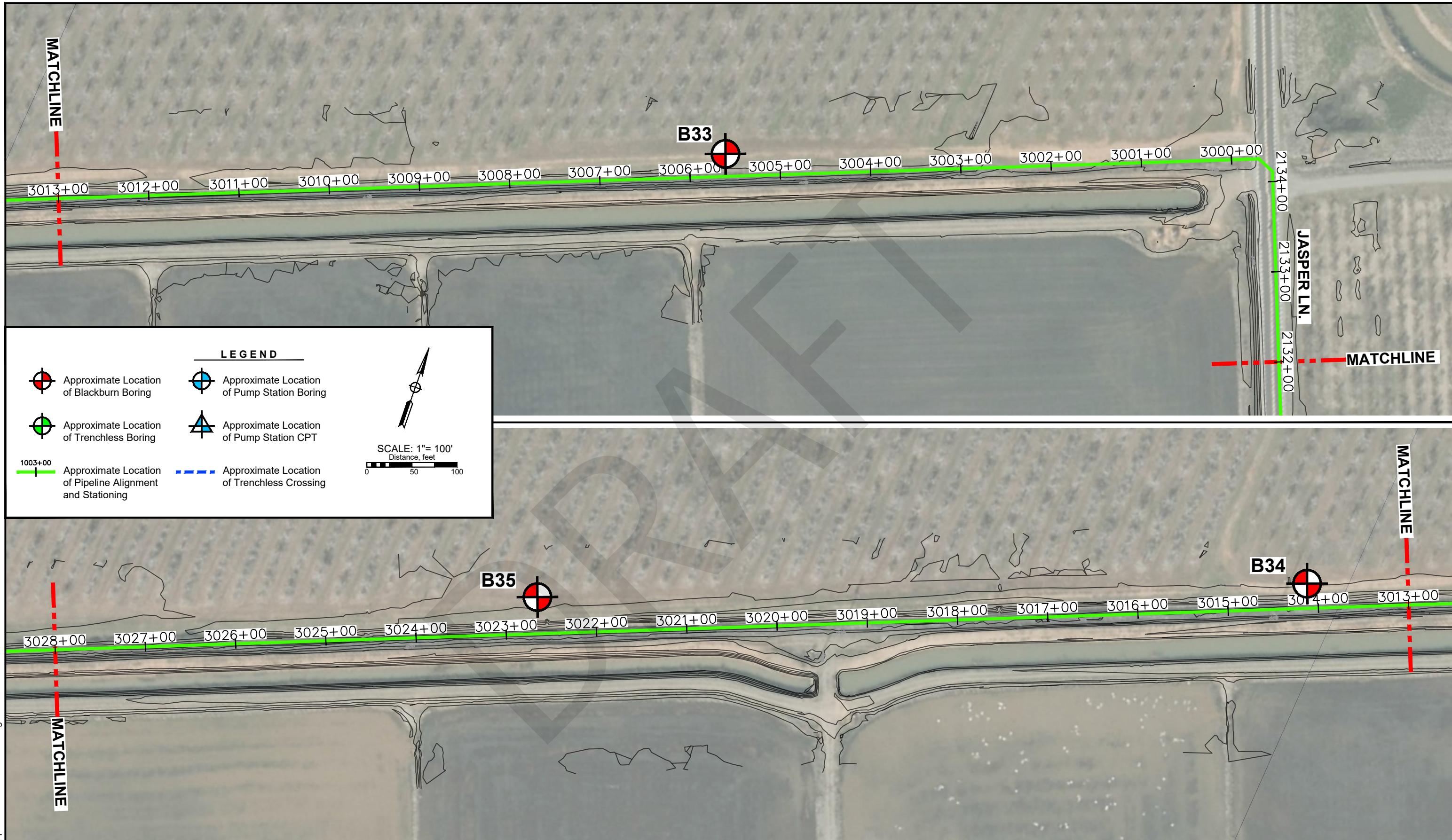
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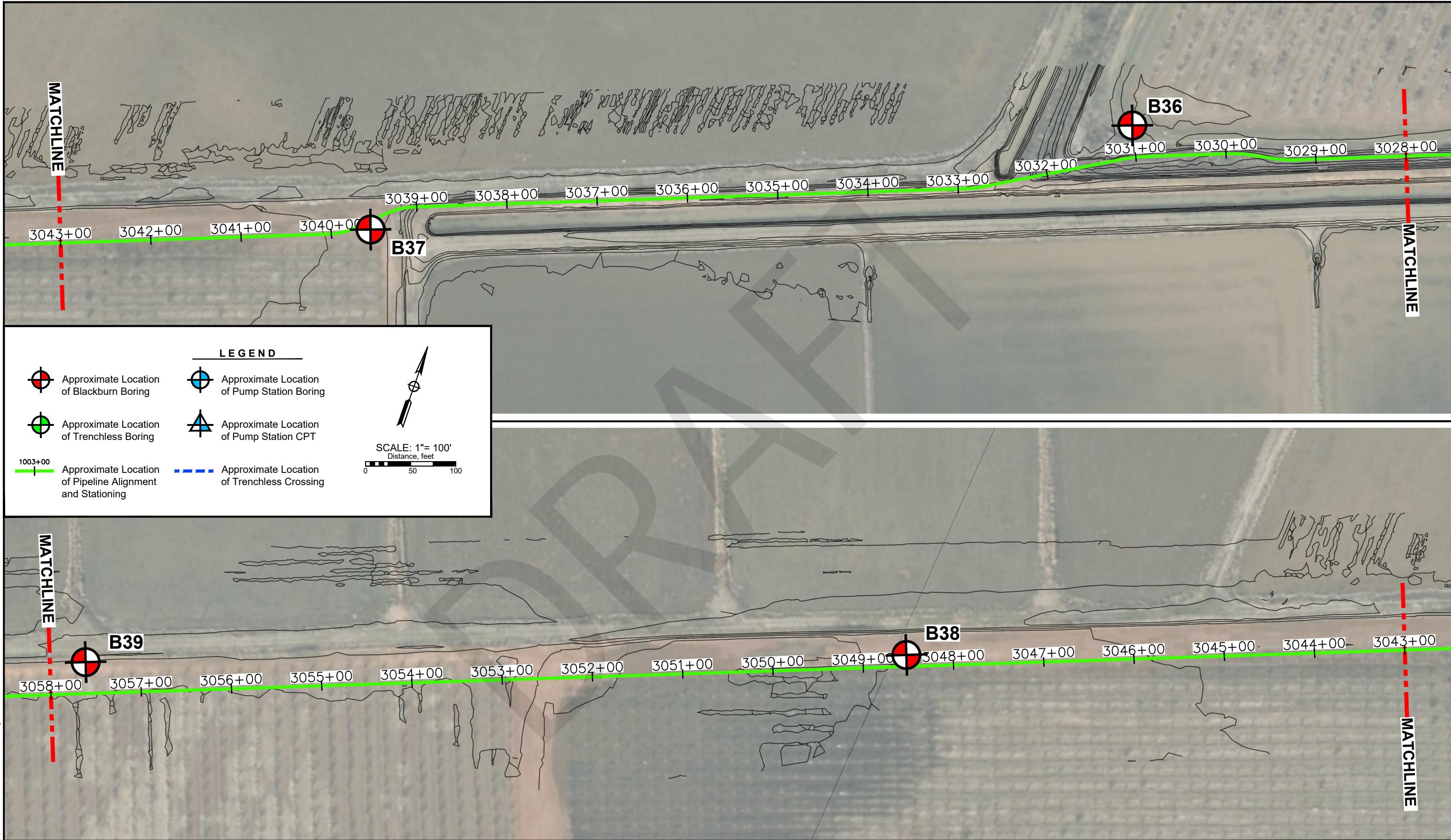


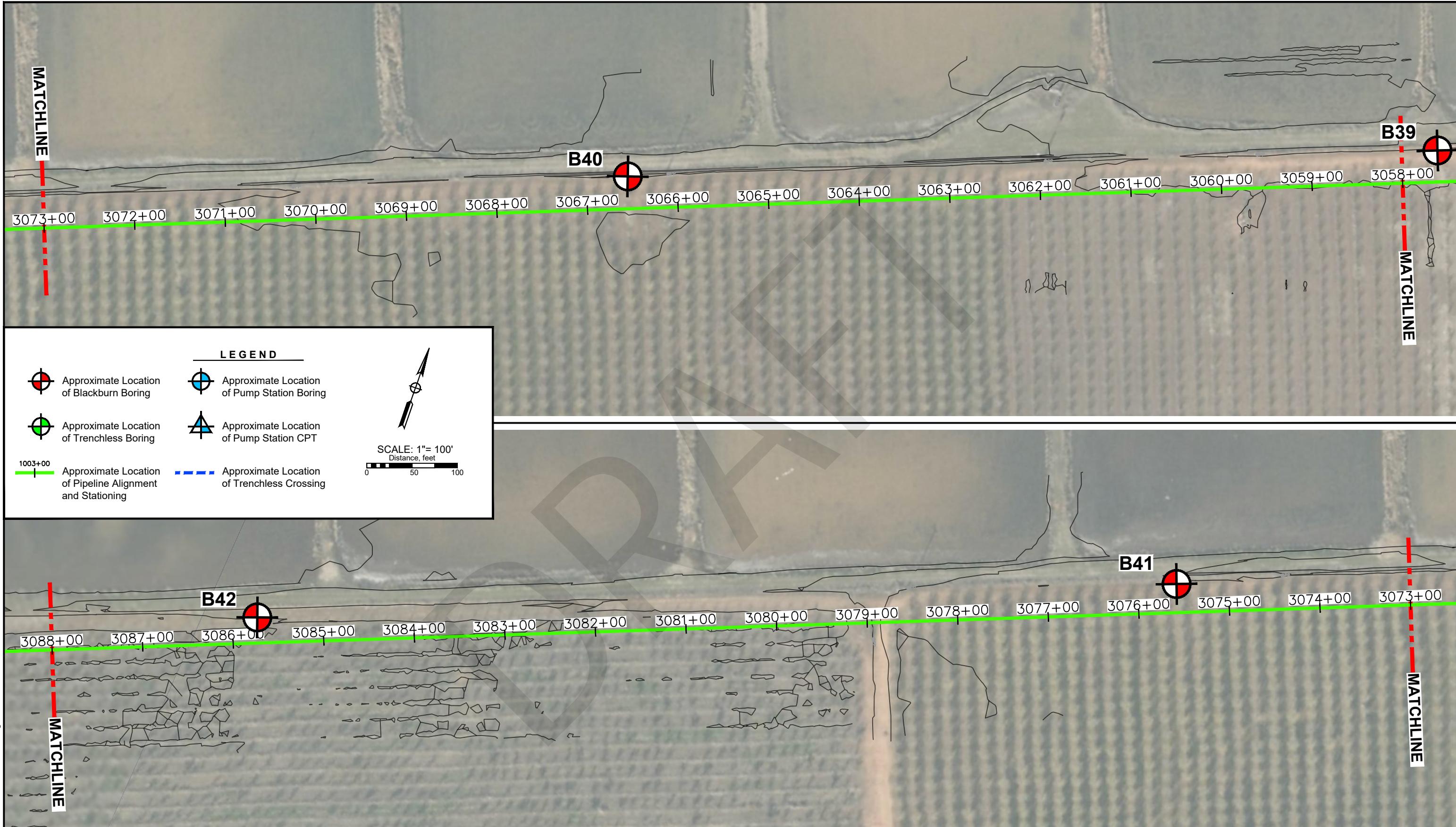


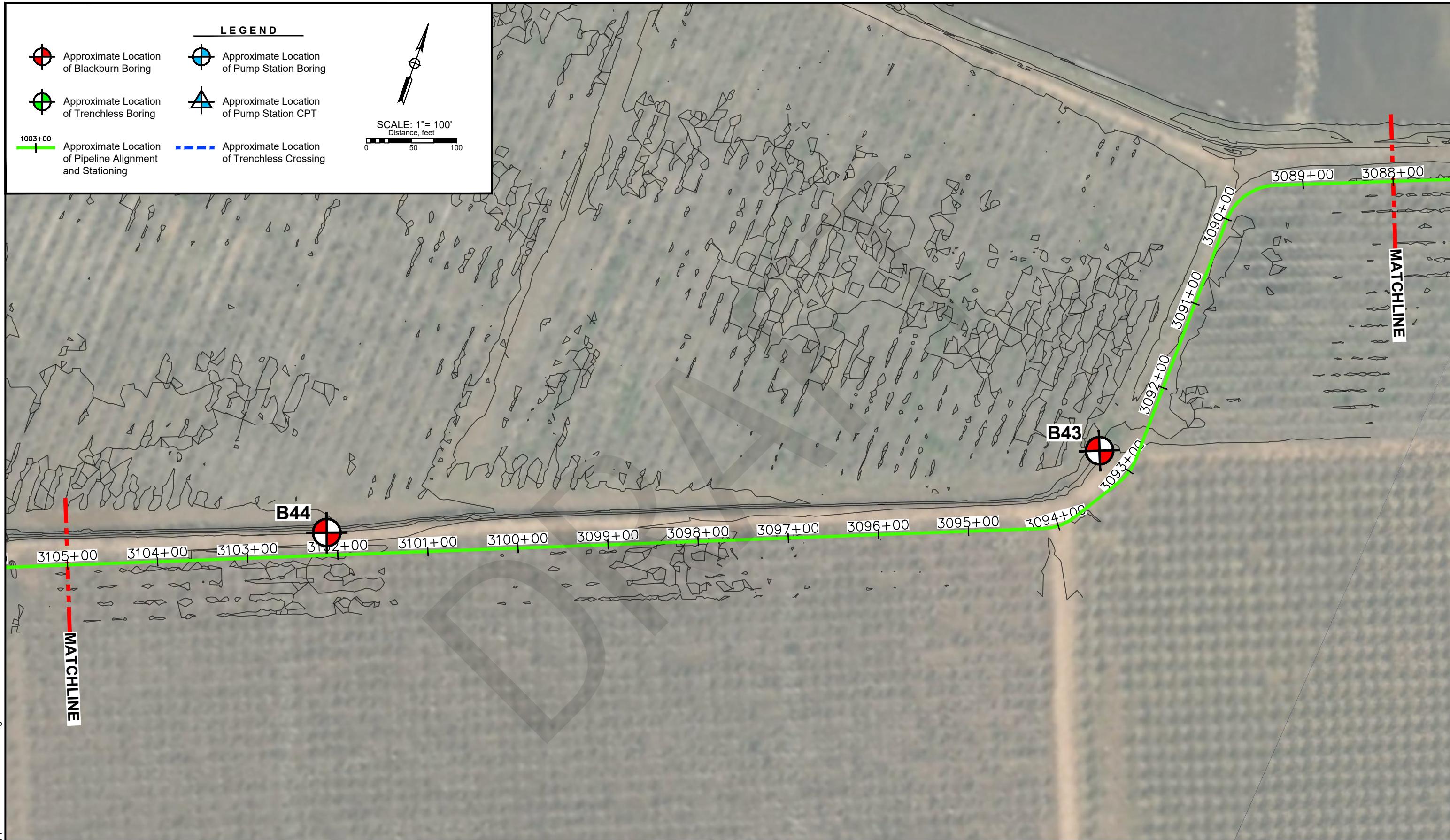


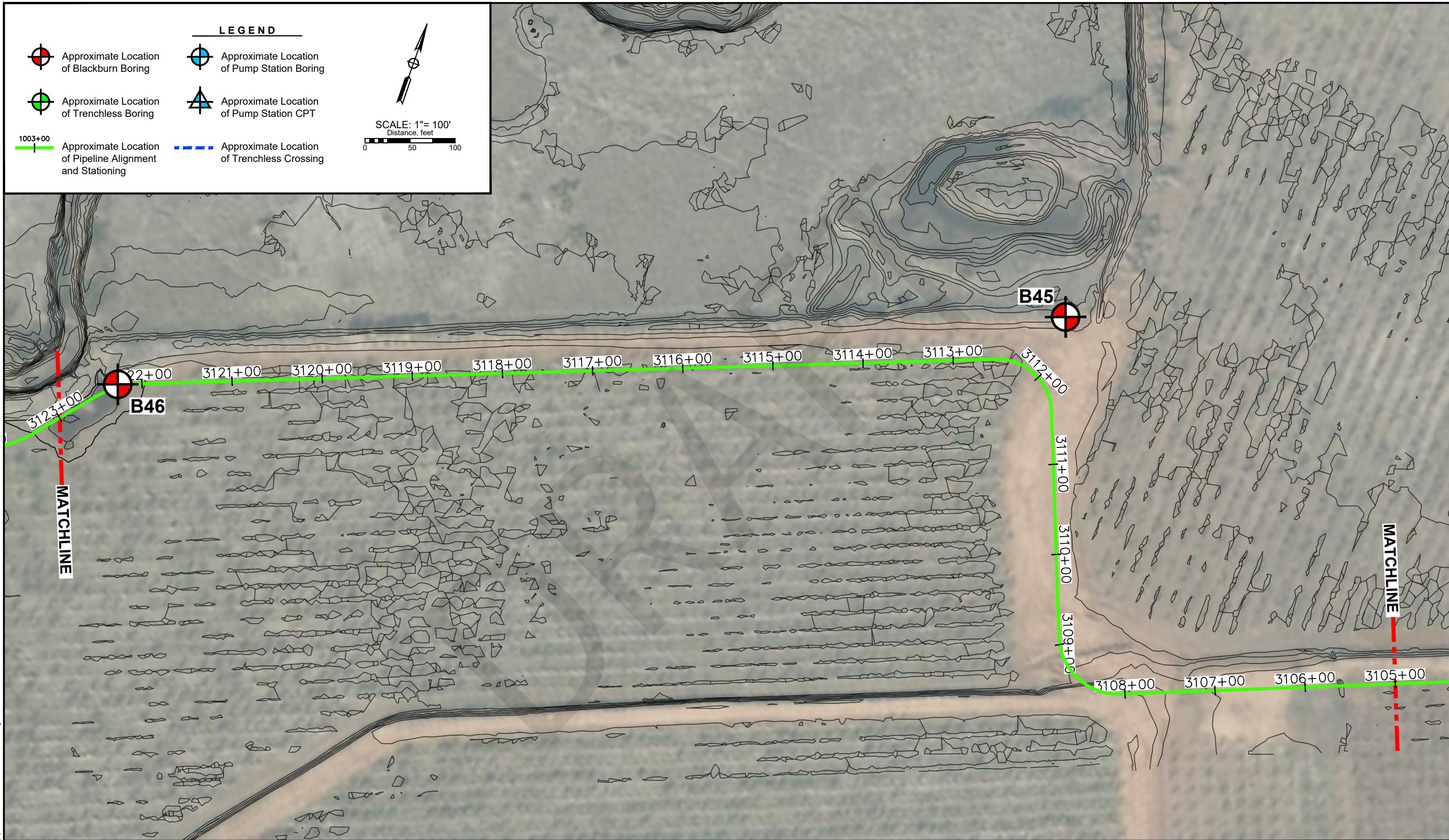


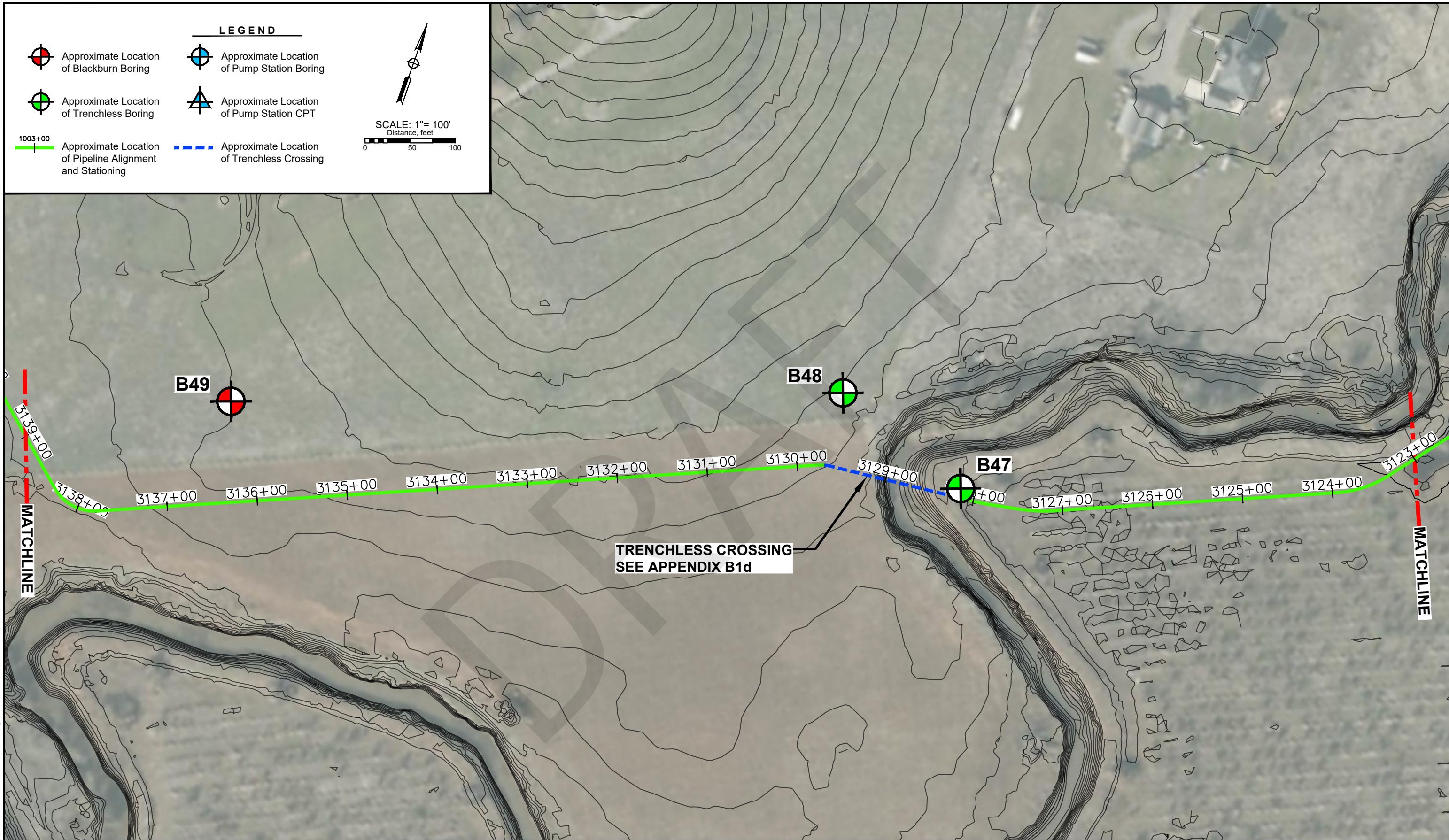


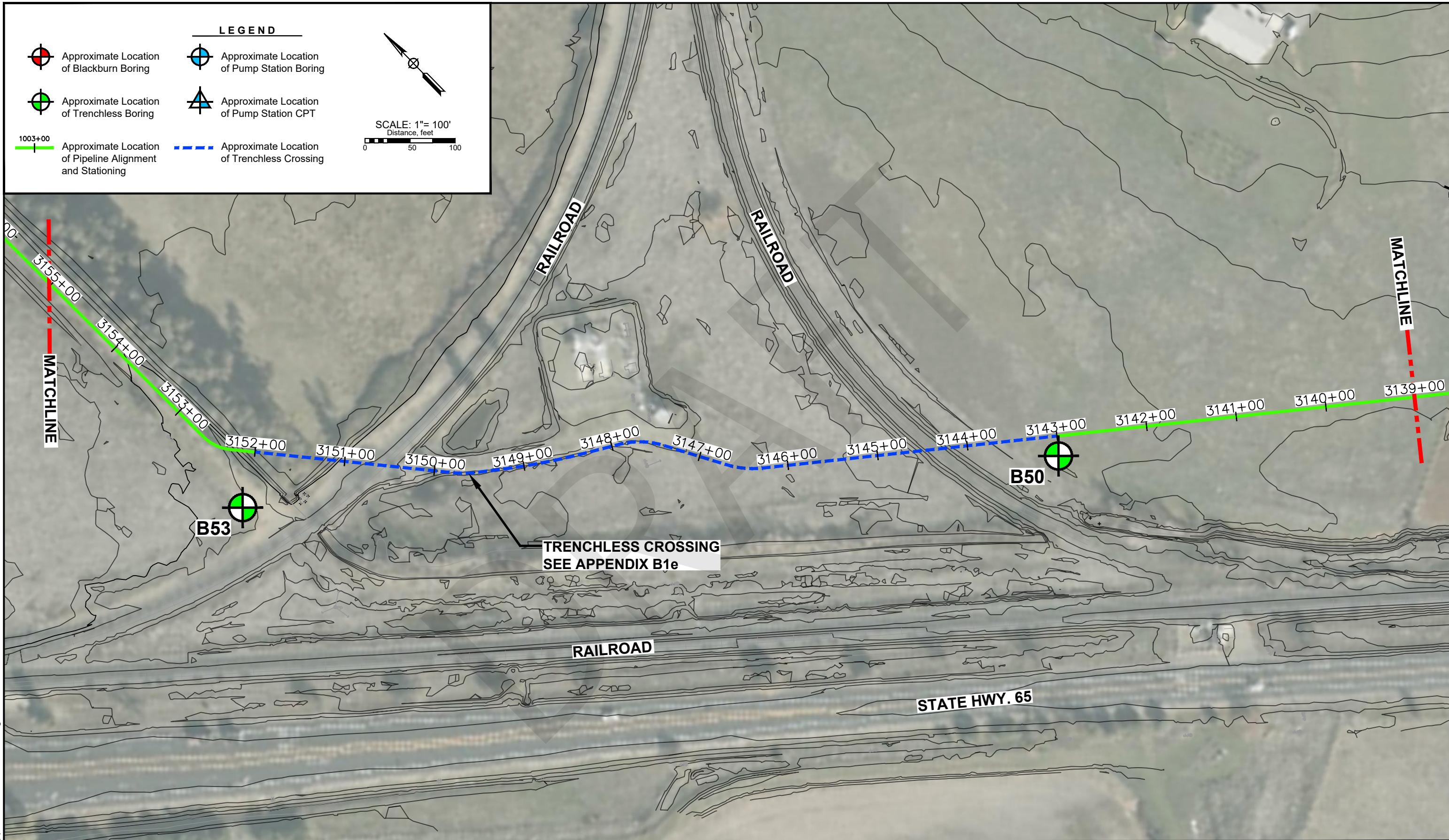












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